GREAT LAKES LEGACY ACT SEDIMENT REMEDIATION RESEARCH ON *IN SITU* TREATMENT

Torch Lake

Introduction

This fact sheet is one of a series of factsheets produced as a result of the U.S. EPA's Great Lakes Legacy Act research effort between the U.S. EPA Office of Research and Development and the USACE Engineer Research and Development Center (ERDC).

To support remediation and restoration efforts at Great Lakes Areas of Concern, this report provides a brief summary of the potential for *in situ* remedial actions for Torch Lake.

Great Lakes contaminated sediment sites contain elevated concentrations of contaminants of concern (COCs), such as metals and hydrophobic organic compounds. *In situ* management of the contaminants via containment or sediment treatment holds significant advantages over removal and *ex situ* treatment and disposal.

Torch Lake is located on the Keweenaw Peninsula within Houghton County on the northwestern shore of Michigan's Upper Peninsula and on Lake Superior's southern shore. This lake was designated as an area of concern (AOC) due to the appearance of fish tumors of unknown origin, which resulted in fish consumption advisories. The chief contaminant of concern is copper, which resulted from 200 million tons of copper ore tailings deposited in the lake for more than a century.

Following Superfund remedial actions that were completed in 2005, there remains some contaminated sediments. *In situ* management of copper in sediments can be accomplished by reducing the availability and mobility of copper in the sediments. Copper is often found in insoluble sulfides under strongly reducing conditions and also can complex with other constituents in sediments or cap materials to reduce availability and mobility. Amendments that achieve one or both goals could be introduced into surficial sediments or into sediment capping materials placed on top of the sediments. Potential amendments that can achieve one or both goals include activated carbon (granular activated carbon (GAC) from Calgon, Aquagate+powdered activated carbon (PAC) from Aquablok, PAC mixed with sand, PAC, fine GAC), apatite (fish bones), and steel slag. Laboratory studies show that GAC, fish bones and steel slag are superior amendments for the removal of copper.

The analysis of sediment *in situ* remediation options such as capping or *in situ* treatment with amendments depends upon accurately determining sediment pore water characteristics. Sediment biogeochemistry can affect contaminant speciation and fate; natural organic matter may affect amendment performance. Natural organic matter and sediment biogeo-chemistry can also interfere with the measurement of contaminants in the interstitial

water. Passive sampling is often required to accurately measure the mobile and available contaminants in the interstitial water. It is for these reasons that site-specific studies were undertaken.

Experimental Studies

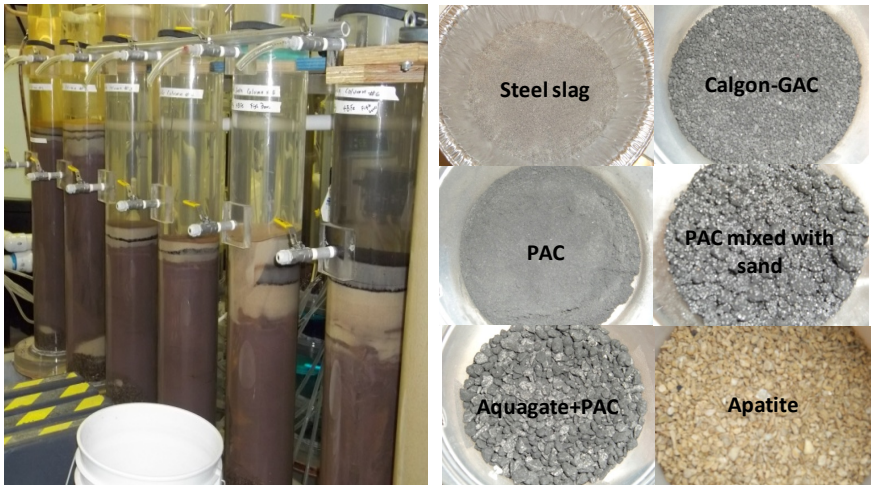

Figure 1. Column setup and amendments used for batch studies.

- The goal of the experimental studies was to assess what types of *in situ* treatments would be most effective at limiting the release of copper from the sediments to the water column.
- Experimental studies were conducted for the Torch Lake site with a number of different sorbent materials using pore water generated from sediment samples collected from the site. These studies include the following:
  - Batch sorption tests to determine dosage using Calgon-GAC, Prominent Systems, Inc.-GAC, PAC, apatite (fish bones), steel slag, Aquagate+PAC, and activated carbon mixed with sand
  - Column tests using GAC, apatite, and steel slag simulating active capping
- Results for the column tests showed that any of the sorbents tested in the columns might be effective for the removal of copper. However, batch sorption tests showed that steel slag is a superior sorbent as compared to the other sorbents (1 to 2 orders of magnitude higher); its sorption capacity is comparable to PAC. This material is also generally considered a waste material and recycling of this material can be advantageous.

In Situ Performance Evaluation

- After a period of 5 months, dissolved copper removal percentages were greater than 90% for all the sorbents tested during the column tests. For certain periods of time shorter than 5 months, the removal percentages were less than 30% (4 months) and 40% (1 month) for one of the replicates of the apatite and GAC columns respectively, due to potential particle transport across the thin cap layer.
- Total copper concentrations are more effectively reduced by the apatite and steel slag amendments.
- A cap amended with steel slag or apatite could dramatically reduce copper flux to the surficial sediments.

Potential Remedial Implementation Based on Laboratory Studies

- Based on the experimental results, an amended cap of apatite or steel slag mixed with sand would reduce the bioavailability of the copper by reducing the flux to the water column.

For Further Information

- **http://epa.gov/greatlakes/aoc/torchlake/index.html**
- **http://www.erdc.usace.army.mil/**
- **http://www.epa.gov/nrmrl/**

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